IYGB GCE

Mathematics FM2

Advanced Level

Practice Paper Q

Difficulty Rating: 3.1333/1.3953

Time: 1 hour 30 minutes

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

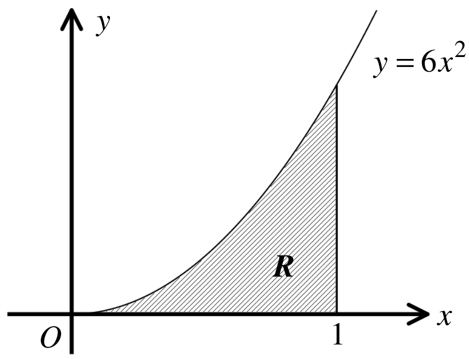
This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 7 questions in this question paper.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

Question 1



The figure above shows the finite region R bounded by the x axis, the curve with equation $y = 6x^2$ and the straight line with equation $x = 1$.

The centre of mass of a uniform lamina whose shape is that of R, is denoted by G.

Use integration to determine the coordinates of G. **(7)**

Question 2

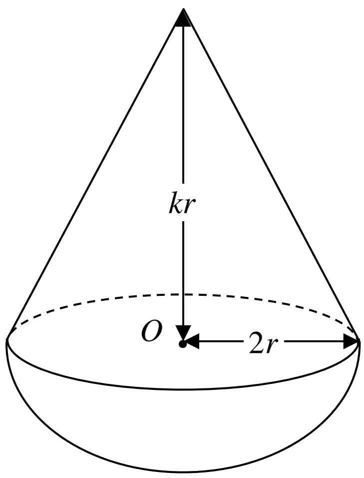
A rough circular plate rotates horizontally with constant angular velocity $\omega \text{ rad s}^{-1}$, about s smooth vertical axis through its centre.

A particle of mass 0.5 kg lies at a point on the plate at a distance of 0.75 m from the centre of the plate.

The particle is connected to the axis through the centre of the plate by an elastic string of natural length 0.6 m, and modulus of elasticity 15 N.

If the coefficient of friction between the plate and the particle is 0.45, calculate the minimum and the maximum value of ω. **(8)**

Question 3



A uniform solid S, consists of a hemisphere of radius $2r$ and a right circular cone of radius $2r$ and height kr, where k is a constant such that $k > 2\sqrt{3}$. The centre of the plane face of the hemisphere is at O and this plane face coincides with the plane face at the base of the cone, as shown in the figure above.

a) Show that the distance of the centre of mass of S from O is

$$\frac{k^2-12}{4(k+4)}r. \qquad (\mathbf{6})$$

The point P lies on the circumference of the base of the cone. S is suspended by a string and hangs freely in equilibrium. The angle between OP and the vertical when S is in equilibrium is θ.

b) Given that $\tan\theta = 0.3$ determine the value of k. **(6)**

Question 4

A particle P of mass 0.5 kg is attached to the free end of a light elastic string of natural length 0.8 m and modulus of elasticity 90 N.

The particle is in equilibrium, hanging vertically from a fixed point A.

The particle is pulled vertically downwards a further 0.5 m and released from rest.

a) Show that in the subsequent motion, P moves with simple harmonic motion. **(6)**

The particle is next pulled vertically downwards a further distance a m below the equilibrium position and released from rest.

b) Given that P passes through the equilibrium position with speed 3 ms^{-1}, calculate the distance P covers until it first comes to instantaneous rest. **(8)**

Question 5

A particle P starts from rest and moves on the x axis with acceleration of magnitude

$$\frac{60}{(t+3)^2} \text{ N},$$

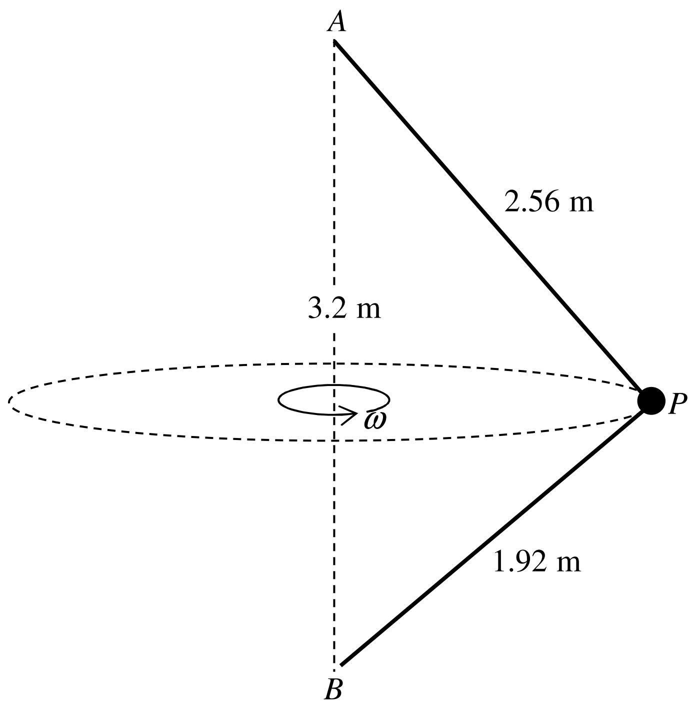
acting in the direction of x increasing.

a) Find an expression for the velocity of P, in terms of t. **(5)**

b) Show that the distance covered by P in the first 6 s of its motion is

$$60(2-\ln 3) \text{ m}.$$ **(7)**

Question 6



A particle P of mass m is attached at the end of two light inextensible strings AP and BP, of respective lengths 2.56 m and 1.92 m. The points A, P and B lie in the same vertical plane with A located at a distance of 3.2 m vertically above B, as shown in the figure above.

The particle rotates in a horizontal circle with constant angular speed ω, with both strings taut.

Show that the time for the particle to make a complete revolution is at most $\frac{32}{35}\pi$. **(12)**

Question 7

A particle is moving on a straight line with simple harmonic motion, centre at O, and period $\frac{1}{3}\pi \text{ s}$.

When the particle is at a distance of 0.48 m from O, its speed is 2.16 ms^{-1}.

Calculate the total time within a complete oscillation, for which the particle has speed less than 2.88 ms^{-1}. **(10)**
